Secret

NPIC/P&DS-29/65
27 January 1965

MEMORANDUM FOR: Chief, [redacted], NPIC

ATTENTION: Chief, Security Branch, IS

SUBJECT: Absolute Surveillance Television Systems

1. The attached unsolicited letter is for your information and for possible forwarding to the Office of Security.

25X1 2. [redacted] contact [redacted] 25X1
has been based on his actual [redacted] to the U. S. Army Photographic Agency, Room 2A470, Pentagon, [redacted] contacts with his friends in the Audio-Visual Directorate, [redacted] to Chief Signal Officer, DA. At
25X1 no time has [redacted] made any [redacted] reference to either the CIA or the NPIC during his conversations with [redacted] personnel at the [redacted] 25X1
25X1 [redacted]

25X1 [redacted]

Assistant for Plans and Development

Attachment:

25X1 [redacted]

Distribution:

Orig & 1 - Addressee
2 - P&DS/BB
1 - P&DS Chrono

25X1 NPIC/P&DS/[redacted]

Declass Review by NGA.

GROUP 1
Excluded from automatic downgrading and declassification

SECRET

[redacted]

Special Activities Division
USAPIC, SF-1312-00, Room 1B945
25X1 Pentagon
Washington, D. C., 20310

[redacted]

25X1 [redacted] is contemplating the design and manufacture of a new type of absolute survillance system.

The system will utilize any television camera for purposes of scanning a given area. In the event of any movement of any type within an area of five scanning lines on the television monitor an alarm will go off or other switching can be accomplished. For purposes of comparison it takes five scanning lines to resolve a standard pica type face.

I feel that this type of survillance system can be absolutely foolproof and would offer greater security than that of any present type of intrusion alarm device on the market today. For those installations presently utilizing television as a means of observation this accessory device will increase the efficiency of the present system by virtue of the fact that the efficiency of the observer goes down about fifty percent after fifteen minutes of viewing the same scene. With the TV alarm device no continuous sight observation would be required. Multiple cameras may be fed into one alarm system.

As further demonstration of the foolproof nature of this proposed system, the failure of any of the components in the system, including the camera, would cause the alarm or switching to go off. Sensitivity can be adjustable to include as many lines of information as desired above five lines.

I would like to know whether your facility would be interested in sponsoring this project with us in any of the following ways -

a. Feasibility study funding.

b. R & D funding.

c. Committed purchase of a number of units sufficient to reimburse us for design and fabrication after acceptance of prototype.

It is anticipated that the price of the unit will be in the range of [redacted] unit in small quantity purchases. As demand increases we anticipate the price to be reduced greatly.

25X1

Your views on this matter would be greatly appreciated.

Very truly yours,

[redacted]

25X1

President

NRS:bdh

Television Line Structure Suppression

By FRANCIS T. THOMPSON

Experiments indicate that television viewers select a viewing distance at which the line structure begins to disappear. If the line structure is destroyed, the preferred viewing distance is reduced to about 60%. Other advantages and the disadvantages of eliminating the line structure are discussed. Several methods of eliminating it are described. The results of an experimental comparison of television pictures with and without structure suppression are given. A photographic comparison is also given.

IT HAS BEEN reported[1] that the most popular vertical viewing angle for movies is approximately 17° while that for television is 8°. Previous data[2] which were verified by experiments described in this paper indicate that the average eye is just able to resolve lines which subtend one minute of arc at the eye. This value of one minute of arc is equivalent to a vertical viewing angle of 7.8° for a picture composed of 480 active lines.

Experiments indicate that television viewers tend to select a viewing angle at which the line structure just begins to disappear. Under these circumstances it is easy to see one reason why the trend toward larger television pictures has declined. The average living room cannot easily provide the minimum $10\frac{1}{2}$-ft viewing distance desired for 24-in. receivers.

It would be desirable to suppress or eliminate the line structure in television pictures thereby allowing the larger receivers to be comfortably viewed at reduced distances. Experiments indicate that the same viewers who chose 8° vertical viewing angles for a conventional picture prefer 10° to 16° angles for a reduced structure television picture.

Presented on April 30, 1957, at the Society's Convention at Washington, D.C., by Francis T. Thompson, Westinghouse Research Laboratories, Westinghouse Electric Corp., Pittsburgh 35, Pa. (This paper was received on April 30, 1957.)

Fundamental Considerations

There are several methods of reducing the appearance of line structure in television pictures. Each must accomplish the same basic task, that of filling in the dark spaces between the scanning lines with information which does not contrast with the scanning lines.

The desired result may be obtained by increasing the vertical dimension of the scanning spot. The effect of the vertical spot dimension on vertical resolution is illustrated in Fig. 1. In (a) of Fig. 1 the spot height is less than the line pitch which is normal in larger size picture tubes. The black space between the scanning lines is distracting. In (b) the vertical spot dimension is equal to the line pitch and represents the maximum spot dimension at which full vertical resolution is retained. In (c) the spot dimension is greater than the line pitch resulting in beam overlapping and a consequent loss of vertical resolution. The most desirable is (b) from the point of view of maximum structure suppression.

Methods of Enlarging the Effective Vertical Spot Dimension

The vertical spot dimension may be enlarged by defocusing the electron spot; however, defocusing also enlarges the horizontal spot dimension resulting in a serious loss of horizontal resolution. The effect of increasing the horizontal spot dimension, which is similar to increasing the aperture of a pinhole camera, is illustrated in Fig. 2. The center of the electron spot produces the desired sharp transition but the overlapping of the outer portions results in a gradual change in brightness. Spot defocusing is not a practical method because of the loss in horizontal resolution.

The ideal electron beam spot from the standpoint of structure suppression and resolution has an effective vertical dimension equal to the line pitch and a very small horizontal dimension. Such a spot is difficult to obtain by electron optics and once obtained is particularly difficult to maintain as the beam is deflected over the face of the tube.

One possible solution to this problem lies in the use of a lenticular plastic screen which is placed against the front of the picture tube.[3] This screen provides a finer line structure by optically superimposing the light from adjacent lines. Superimposing light from several lines results in a loss of small area contrast however, and thereby decreases the sharpness of the picture. Figure 3 shows a portion of a television picture in which the line structure is very obvious. The structure is reduced by the lenticular screen as shown in Fig. 4.

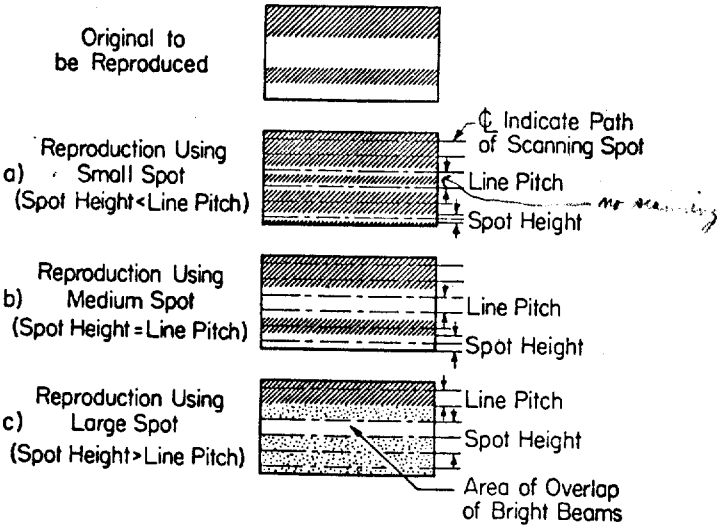

Fig. 1. Effect of vertical electron spot dimension on vertical resolution.

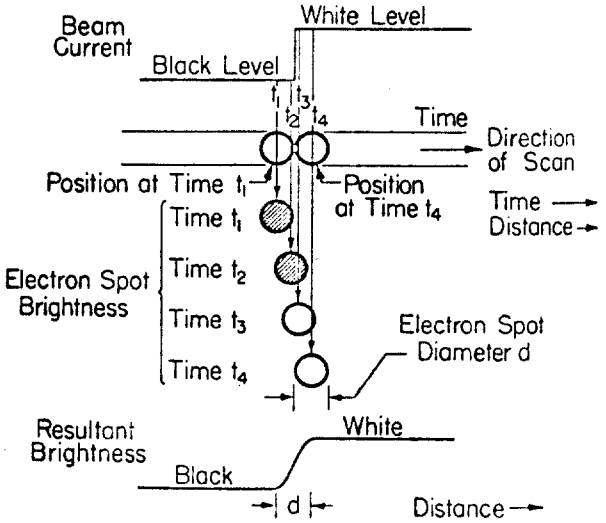

Fig. 2. Effect of horizontal spot diameter on horizontal resolution.

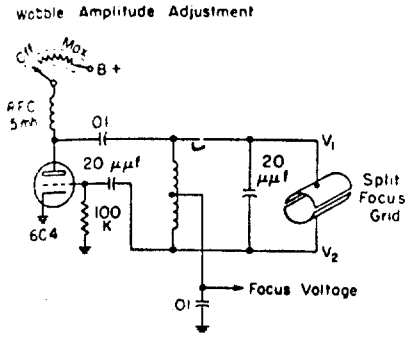

Fig. 5. Spot-wobble oscillator circuit.

The small horizontal spot dimension of a well-focused spot may be retained if the effective vertical spot dimension is enlarged by adding a low-amplitude high-frequency vertical deflection to the existing sawtooth deflection at the receiver. The frequency can always be made high enough so that the individual cycles of the vertical deflection are not visible. The amplitude of this deflection is adjusted so that the scans of adjacent lines are tangent as in Fig. 1(b).

This technique which is known as spot wobble is used commercially in England to compensate for their coarser line structure.[4–6] The English 405-line system exhibits the same line structure on a 21-in. receiver as our 525-line system does on a 27-in. receiver. In the British system a free-running oscillator with small auxiliary vertical deflection coils as part of the resonant tank was used to wobble the spot. Each coil consisted of a few turns of wire wound on the neck of the picture tube.

A free-running oscillator and auxiliary coil combination has several disadvantages:

1. The low Q of the auxiliary coils necessitates a high driving power and results in an increase in the amplitude of harmonics which may produce interference in the receiver.
2. It is difficult to resonate auxiliary deflection coils at frequencies above 10 mc. The wobble pattern is quite noticeable at lower frequencies.
3. Difficulty has been experienced from voltage breakdown between the auxiliary coils and conventional deflection yoke.

Improved Spot Wobbler

The problems associated with electromagnetic spot wobble may be eliminated by an electrostatic system is used. Eros [illegible] and James A. Hall of the Westinghouse Electronic Tube Div. have developed a special TV picture tube which contains a split cylindrical focus grid. The electron beam may be deflected vertically if a potential difference is applied between the halves of the split grid. The application of this tube to spot wobble was suggested by the author.

The capacitance between the split grid elements, which is only a few micro-microfarads, may be made a part of the tuned circuit of a high-frequency oscillator as illustrated in Fig. 5.

This arrangement has several advantages:

1. The oscillator-split grid combination results in a high Q which minimizes driving power and reduces oscillator harmonics.
2. High frequencies can be obtained easily because of the low capacity of the split grid.
3. The production cost of splitting the focus electrode is small when compared with the cost of auxiliary deflection coils.

Photographic Results

Photographs were taken using a 21-in. receiver equipped with a split grid focus tube. A picture transmitted by a 245-line, 2.5-mc bandwidth, 60-field/sec, two-to-one vertical interlace system was displayed on a 12 by 16-in. area of this tube. The line structure is equivalent to displaying a conventional 525-line picture on a 36-in. picture tube. The amplitude of the 25-mc wobble was adjusted by varying the d-c oscillator supply voltage. The wobble amplitude was adjusted until the scanning lines were tangent and a photograph was taken. The oscillator was turned off and a conventional line scan picture was photographed. No other adjustments were made. The results are shown in Figs. 6 through 11.

The lines are much less apparent in Figs. 7, 9 and 11. The lines in Figs. 6, 8 and 10 spoil the continuity of the pictures and tend to mask high-detail information if the picture is viewed too closely. Reducing the apparent structure allows the viewer to enjoy the detail and to sit closer to the screen. Although the pictures contain the same amount of detail, some viewers stated that the wobble picture appeared to contain more detail than the conventional-scan picture.

The vertical resolution of the test patterns of Figs. 10 and 11 is low as seen in the horizontal wedges, because of the 245-line raster. The horizontal resolution is higher than would be expected with a 2.5-mc bandwidth because of the 136-μ second horizontal period. A comparison of the conventional scan of Fig. 10 with wobble scan of Fig. 11 shows that the resolution is not noticeably degraded by the addition of spot wobble.

Subjective Experiments

A. 245-Line Picture

Fifty observers individually viewed the conventional and the spot-wobble pictures of Figs. 6 and 7 on the 21-in. receiver. They were asked to view the set closely and then move back to a distance where they could comfortably view the picture. The number of observers sitting closer than a given distance is plotted in Fig. 12 for the conventional and spot-wobble pictures. The variation in vision was eliminated by taking the ratio or the viewing distance for the spot-wobble picture to the viewing distance for the conventional picture. The distance ratios were grouped and plotted in Fig. 13.

This experiment indicates that the viewing distance for larger receivers is determined by the line structure rather than the picture detail.

B. 525-Line Raster

A group of fifty viewers was used to determine the distance from a 24-in. receiver at which the line structure becomes barely resolvable. The test was conducted using a standard 525-line television raster with no video modulation at a brightness of 20 ft-L. The viewers backed away from the receiver until the lines just blended together. Distances were recorded for the conventional raster and the wobbled raster using a 13.2-mc wobble deflection voltage. The number of observers sitting closer than a given distance is plotted in Fig. 14 for the conventional and spot-wobble raster. The ratio of the viewing distance for the spot-wobble raster to the conventional raster is plotted in Fig. 15.

The average viewing distance for the conventional raster, 10.6 ft, corresponds to a vertical viewing angle of 7.6°. This result is close to the 7.8° value calculated from the one minute of arc resolution. The average distance for the wobbled raster, 6.1 ft, corresponds to a vertical viewing angle of 13.1°.

A further experiment was conducted using a live telecast on this same 24-in. receiver. A number of the same viewers were seated in a chair with casters and asked to move about and pick the location from which they preferred to view the receiver. When a conventional line picture was shown they chose approximately the same distance that they had selected in the previous experiment with a conventional raster. When the wobble was added they moved closer to the receiver and chose approximately the same location at which the wobbled line structure had disappeared.

This experiment indicates that the 8° viewing angle chosen by TV viewers was determined by the line structure. Viewers can be expected to choose viewing angles as large as 13° with reduced structure television. The use of these moderately larger viewing angles can be expected to increase the popularity of

ures 3, 4 and 6–11 appear on pp. 604 and 605.

Fig. 3. Line-scan reproduction.

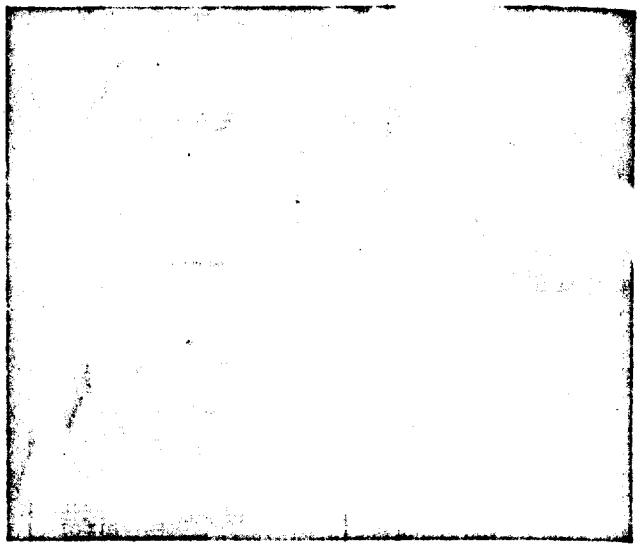

Fig. 4. Lenticular lens structure suppression reproduction.

Fig. 6. Line scan.

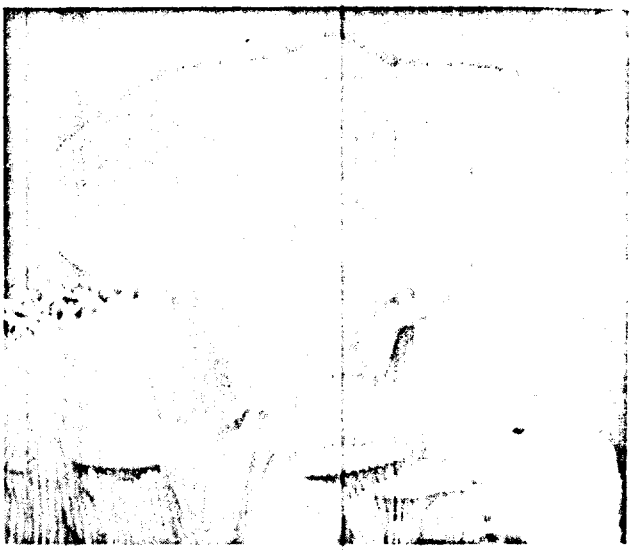

Fig. 7. Spot-wobble reproduction.

Fig. 8. Line-scan reproduction.

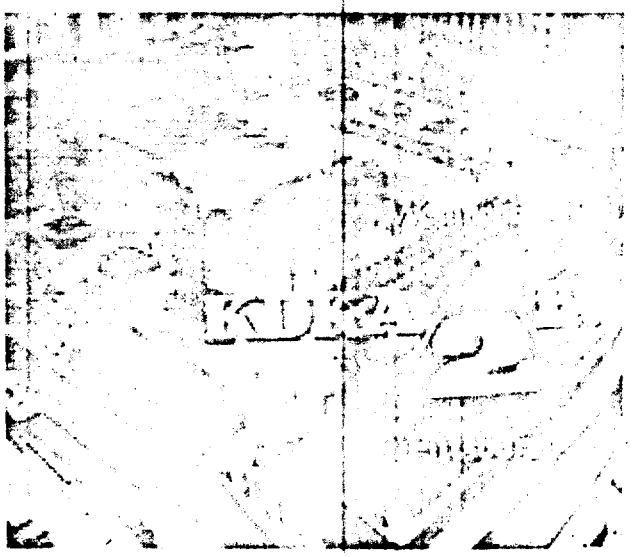

Fig. 8. Spot-wobble reproduction.

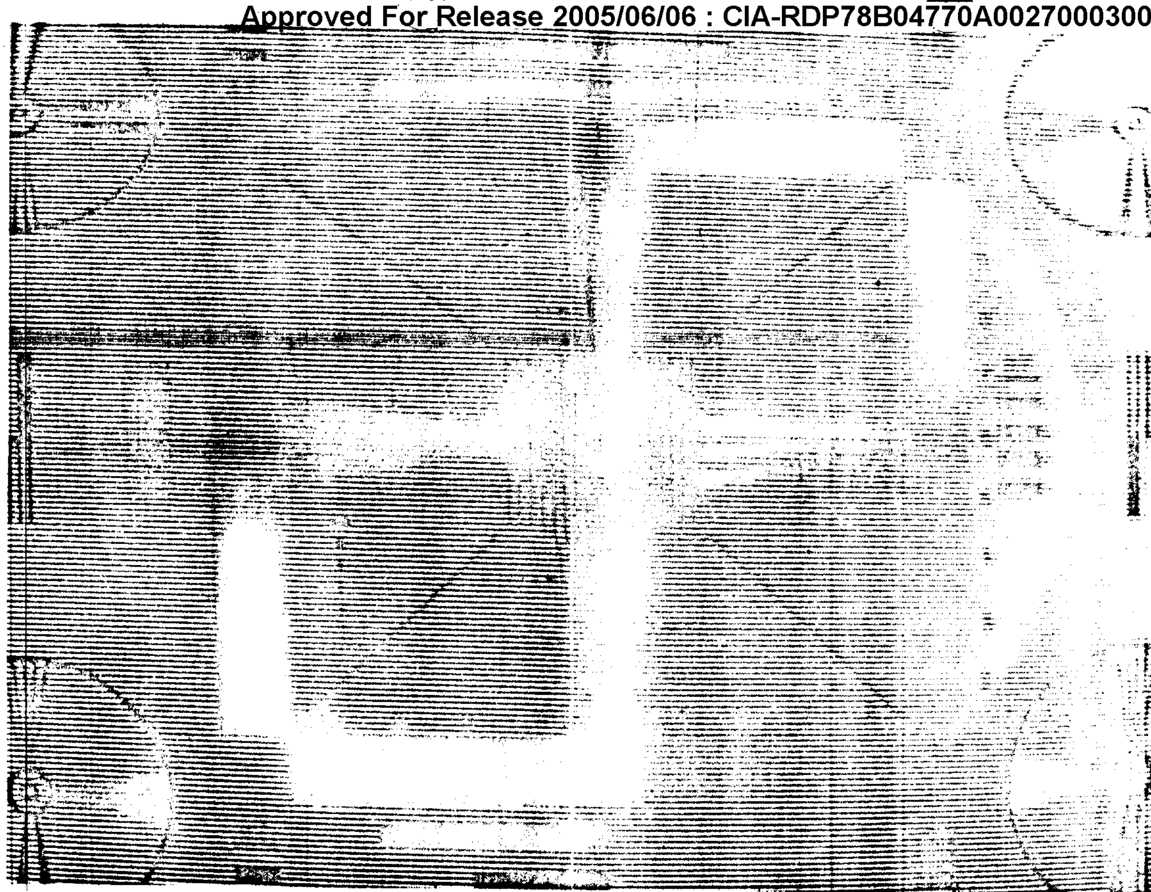

Fig. 10. Line-scan test reproduction.

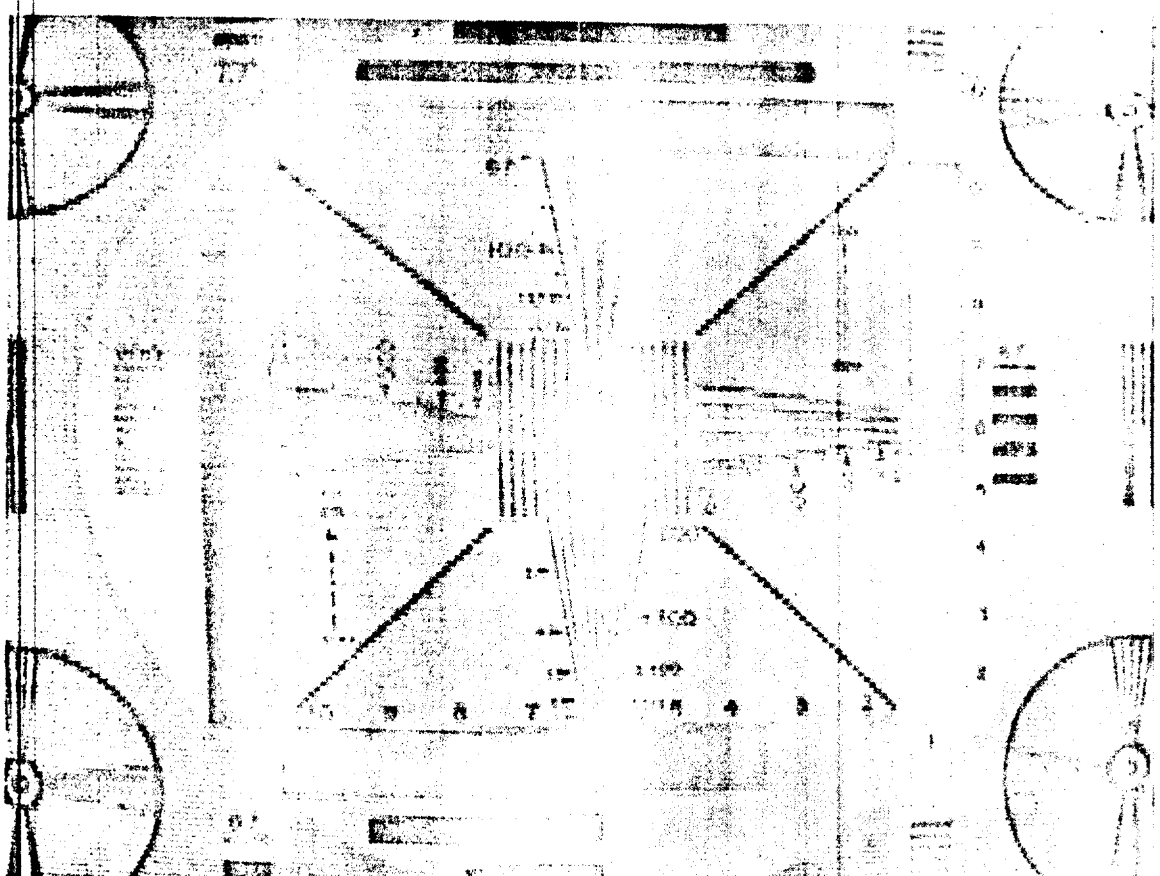

Fig. 11. Spot-wobble reproduction.

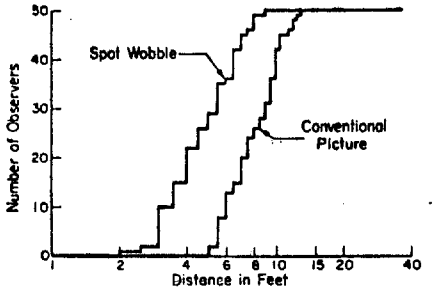

Fig. 12. Observers sitting closer than a given distance (245-line picture).

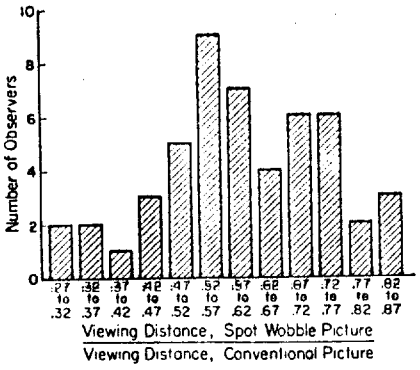

Fig. 13. Effect of spot wobble on viewing distance (245-line picture).

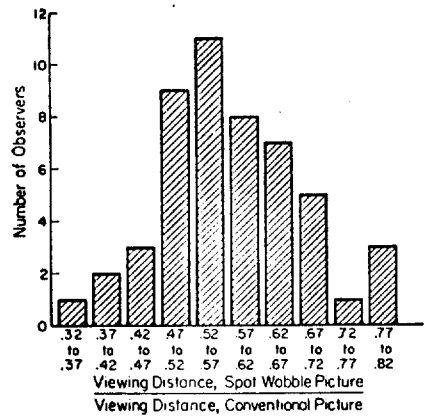

Fig. 15. Effect of spot wobble on viewing distance (525-line raster).

large-screen TV receivers since they can be comfortably viewed in the average livingroom. The inherent picture detail present in a 4-mc TV picture will probably prevent the use of viewing angles larger than 15°.

Conclusion

The results obtained using the 21-in. receiver and the conventional 24-in. receiver to which split grid guns and single tube wobbler circuits were added indicate the desirability of structure reduction.

References

1. D. G. Fink, "Color television vs. color motion pictures," *Jour. SMPTE, 64:* 281–290, June 1955.
2. P. Moon, *The Scientific Basis of Illuminating Engineering* (1st ed.), pp. 422–423, McGraw-Hill Book Co., New York, 1936.
3. S. I. Tourshov, U.S. Patent 2,728,013.
4. R. W. Hallows, "Spot wobble improves TV," *Radio Electronics*, p. 29, May 1950.
5. "Television spot wobbler," *Electronics*, p. 212, July 1952.
6. British Patent 535,905.

Discussion

G. L. Beers (*Radio Corp. of America*): In the curves which you showed, where the people sat closer, I noticed that your test pattern indicated horizontal resolution of 400 or 500 lines. Was the system that you used in obtaining the information as to where the people would sit capable of that resolution or was it limited to something of the order of 300 or 350 lines, which is typical of standard broadcasting?

Mr. Thompson: A 2.5-mc bandwidth was used with the 245-line display. The horizontal resolution is equivalent to that obtained with 5 or 6 mc in a conventional 525-line display.

Dr. Beers: And when you used the 525 lines you just had a blank raster?

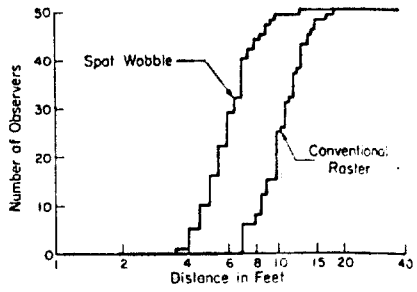

Fig. 14. Observers sitting closer than a given distance (525-line raster on 24 in.).

Mr. Thompson: That's right.

Dr. Beers: I would like to ask, then, whether with spot wobble and with the limitations of standard broadcasting, could the person who sat closer actually get any more information out of the picture than if he sat back at a distance where he could just barely recognize line structure?

Mr. Thompson: We did run an additional experiment on this 24-inch receiver using a live telecast, but the results were not accurately recorded. Approximately 20 of the 50 observers who viewed the blank raster were asked to repeat the experiment using a live telecast. When spot wobble was added they moved closer and closer approximately the same position that they had chosen in the blank raster experiment.

Dr. Beers: But you did not make any tests at all to determine whether, when you used spot wobble, they could actually see anything additional in the picture by sitting closer.

Mr. Thompson: That's correct.

F. N. Gillette (*General Precision Laboratory*): In working with projection equipment using spot wobble we observed one of the first improvements that the general observer picked up was that "line crawl" disappeared rather completely and rather startlingly, when the lines just merged; that is line crawl brought into existence by either movement of the observer's head or movement of objects in the scene either up or down. In your observation of direct-view tubes, do you either confirm the fact that the effect exists also in direct view or do you find it not to be the case?

Mr. Thompson: Although spot wobble does suppress the appearance of structure on still or slowly moving objects it does not eliminate vertical interlace breakup when the viewer's head or the subject moves rapidly in the vertical direction

[redacted] briefing

Nr. of scan lines (4½" vidicon)	11,500
Lens focal length	100 inches
Vidicon target resolution	50 line pairs/mm
Ground resolution	286 ft./TV line
Ground coverage	380 x 380 mi/TV line
Transmission rate	25 seconds/frame
Bandwidth	2.3 mc.
Weight, less lens	75. lbs.
Power required	150 watts

Format	35 mm
Ground res. at 600 NM orbit	0.2 NM
Response	60% at 12 lp/mm
Signal: Noise ratio	40 db
Dynamic range (10 ±2 steps)	0.003 to 0.1 FCS
	0.1 to 0.2 Non-Sat
Readout bandwidth	680. KC
Readout time	5 min (per frame)
Weight, incl. electronics	~3 lbs.
Volume	1053 in^3

Electronics package is 6" X 7" X 13"